HYBRIDIZATION OF SOME PUMPKIN LINES IN RELATION TO OIL CONTENT AND SEED YIELD

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B.Sc. Agric. Sc. Zagazig University-Benha Branch (1999)

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ABSTRACT

Mohamed Adel Fadl Abdel-Daeem El-Tahawey: Hybridization of Some Pumpkin Lines in Relation to Oil Content and Seed Yield. Unpublished Ph.D. Dissertation, Department of Horticulture, Faculty of Agriculture, Ain Shams University 2015.

This study was carried out during the two summer seasons of 2012 and 2013 at the Experimental Farm of El-Kasaseen Research Station, Ismailia Governorate, Egypt. The main objectives of this study was to produce some local F_1 hybrids of pumpkin characterized with high fruit, seed yielding and high seed oil content through a 5 × 5 half diallel to study the following: (1) level of heterosis in the F_1 hybrids over both the mid and the better parents, (2) degrees of dominance and recessiveness for the studied characters by estimating the potence ratios, (3) GCA and SCA of parents and crosses respectively, that will identify superior parents and cross combinations, and (4) the possible association existed between all possible pairs of the studied characters.

Ten F_1 hybrids of pumpkin produced by a half diallel cross were evaluated along with their five inbred lines in order to detect the general performances and estimate the heterosis percentages, potence ratios, combining ability and correlation coefficients of some economic traits. For total yield/plant, the hybrids showed a range of heterosis percentages from -56.1 to 77.6% and from -66.8 to 54% over the mid and higher parent, respectively. Large blue Hubbard x A15 and Indian line x A15 hybrids had the highest significant heterotic effects of 77.6% and 54% over the mid and higher parent, respectively. Most of F_1 hybrids reflected positive heterotic effects for number of seeds/fruit and seed oil content, while most of F_1 hybrids gave negative values of heterosis for weight of seeds/fruit, weight of 100 seeds and seed yield/plant when estimated, especially, with the higher parents.

Variances due to GCA and SCA were highly significant for all the studied traits except for the weight of 100 seeds, indicating the

involvement of both additive and non-additive types of gene action in the inheritance of these traits. The estimates of general combining ability revealed that none of the parents was a good general combiner for all the characters consistently; Indian line was the best combiner for vine length, number of fruits/plant and seed oil content, Red Kuri for flowering earliness and both Indian line and A15 for flesh thickness, average fruit weight and total yield/plant. A15 was the best combiner for number of seeds/fruit, weight of seeds/fruit and seed yield/plant. Indian line x A15 showed the highest positive estimated values for number of fruits/ plant, total yield/ plant, weight of 100 seeds, seed yield/plant and seed oil yield/plant. In addition, vine length, leaf area, fruit flesh thickness, number of fruits/plant and average fruit weight should be used as selection criteria for improving the fruit yield, while number of days to first female flower, flesh thickness, fruit weight, number of fruits/plant, total yield/plant, number of seeds/fruit, weight of seeds/fruit, weight of 100 seeds, seed yield/plant and seed oil concentration should be used as selection criteria for improving seed oil yield of pumpkin.

Key words: Pumpkin, Heterosis, Potence ratio, Combining ability, Correlation, Fruit yield, Seed oil.

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1. INTRODUCTION

Pumpkins belong to the genus *Cucurbita* of the family of Cucurbitaceae which is one of the largest families of vegetable crops. They are classified to *Cucurbita pepo*, *Cucurbita moschata*, *Cucurbita maxima* and *Cucurbita mixta*, according to the texture and shape of their

stems **(Rakcejeva *et al.*, 2011)** and they are widely grown and consumed in many tropical and sub-tropical countries around the world **(Juna *et al.*, 2006)** for their fruits which a good source of minerals, fibres, vitamins, antinutrients, antioxidants and phytonutrients **(Aruah *et al.*, 2010; Atuonwu and Akobundu, 2010)**. In addition, pumpkin seeds are excellent sources of both oil (37.8–45.4%) and protein (25.2–37%) **(Lazos, 1986)**. Pumpkin seed oil is one of edible oils **(Murkovic *et al.*, 1996)** which is used in the preparation of some salads, giving them a very agreeable taste **(Murkovic *et al.*, 2004)**. Also, pumpkin seed oil has been implicated in pharmacological activities such as anti-diabetic **(Li *et al.*, 2003)**, antifungal **(Wang and Ng, 2003)**, antibacterial and anti-inflammation activities **(Fu *et al.*, 2006)** and antioxidant effects **(Nkosi *et al.*, 2006)**.

In Egypt, one of the major problems in pumpkin cultivation is a lack of high yielding cultivars along with a lack of local high yielding hybrids. The productivity of this crop should be increased by improving the genetic architecture through hybridization between different cultivars or through selection of high yielding cultivars. Estimation of heterosis, potence ratio and combining ability effects of yield and its components should be placed greater emphasis for the improvement of this crop through hybridization, while estimation of correlation between the different traits should be useful for the improvement of this crop through selection.

Diallel cross is a useful tool to produce promising hybrids and to study the heterotic effects of these hybrids over their respective parents. In pumpkin, there are reports of high heterosis to the extent of 181.5% and 97.52 % for yield, 70% for more number of female flowers, 68.7% for fruit weight and 150% for number of fruits **(Mohanty and Mishra, 1999b; Pandey *et al.*, 2002)**.

Combining ability helps to identify the best parents and provide sufficient genetic information on the inheritance of a character. In this regard, highly significant variances were observed for both general and

specific combining ability for days to first female flowering, node at which first female flower appears, number of fruits/plant, average fruit weight, and total yield/plant **(Jha *et al.*, 2009)**.

Correlation measures the mutual association between two variables. The result of correlation is of great value in the determination of the most effective procedures for selection of superior genotypes. When there is a positive association of major yield characters, component breeding would be very effective but when these characters are negatively associated, it would be difficult to exercise simultaneous selection for them in developing a cultivar. In this regard, the highest significant positive association of fruit yield per vine with average fruit weight followed by vine length, leaf size, fruit flesh thickness and number of fruits per vine was detected **(Shivananda *et al.*, 2013)**.

Therefore, the main objectives of this work was to produce some local F_1 hybrids of pumpkin characterized with high fruit, seed yielding and high seed oil content through a 5 × 5 half diallel to study the following: (1) level of heterosis in the F_1 hybrids over both the mid and the better parents, (2) degrees of dominance and recessiveness for the studied characters by estimating the potence ratios, (3) GCA and SCA of parents and crosses respectively, that will identify superior parents and cross combinations, and (4) the possible association existed between all possible pairs of the studied characters.

2. REVIEW OF LITERATURE

In order to have a wide view on the subject of this thesis, the review of literature will be subdivided under the following items:

1. Heterosis and potence ratio.
2. General and specific combining abilities.
3. Genotypic and phenotypic correlation coefficients between characters.

4. Fatty acids analysis of pumpkin seed oil.

2.1. Heterosis and potence ratio

Working on diallel analysis of 45 F_1 hybrids of *Cucurbita moschata* Duch. ex Poir, **Sirohi *et al.* (1986)** found that over-dominance was observed for vine length, days to open first female flower, number of fruits/plant and yield/plant, and dominance for fruit weight and flesh thickness. Epistasis was pronounced for all the characters. Recessive alleles were predominant for days to first harvest and dominant alleles for the other characters.

Saha *et al.* (1992) reported 15.5 to 27.0 nodes for first female flower bearing among the pumpkin genotypes. The highest significant ($p<0.05$) positive mid and better parent heterosis for female flowers per plant was exhibited by the hybrid OP 20 × OP 02 followed by OP 04 × OP 20. The highest significant ($p<0.05$) positive mid and better parent heterosis for individual fruit weight was observed in the hybrid OP 10 × OP 20. Significant ($p<0.05$) and desirable level of mid parent heterosis was observed in six hybrids for fruit yield per plant and better parent heterosis in four hybrids. Only one hybrid (OP 10 × OP 20) for mid parent heterosis and another one (OP 20 × OP 02) for better parent heterosis showed significant ($p<0.05$) positive value for all the yield related traits including fruit yield per plant. Six hybrids in both case showed significant and desirable heterosis for number of fruits per plant.

Evaluating an 8 x 8 half diallel cross of pumpkin with its 8 inbred parents for heterosis of yield and yield attributing characters, **Mohanty and Mishra (1999)** found that heterosis over the better parent was observed for vine length (17.8%), number of primary branches/plant (18.1%), number of female flowers/plant (70.0%), number of fruits/plant (150.0%), average fruit weight (68.7%), flesh thickness (48.4%) and yield/plant (181.5%). Crosses between high x low performing (general combining ability) parents exhibited greater hybrid vigour. Heterosis for yield was generally accompanied by heterosis for yield components. Ten

promising crosses were identified for developing high yielding F1 hybrids/varieties of pumpkin with many desirable traits.

Mohanty and Mishra (1999a) evaluated an 8-parent half-diallel cross with parents for heterotic manifestation of yield and yield components. Heterosis to the extent of 37.7, 76.9, 142.9, 96.3, 48.9 and 188.7% over better parent and 52.1, 89.6, 161.5, 109.9, 68.9 and 197.1% over mid-parent was recorded for vine length, female flowers, fruits/plant, average fruit weight, flesh thickness and yield/plant, respectively. Yield heterosis was the cumulative effect of heterosis for most yield attributes. Vine length did not contribute much towards yield. The crosses between high × low performing (GCA) parents exhibited greater hybrid vigour. Eight promising hybrids were identified for developing high-yielding F_1 hybrids/varieties of pumpkin with desirable fruit characters.

Mohanty and Mishra (1999b) evaluated an 8 x 8 half diallel cross of pumpkin was evaluated with parents for heterotic manifestation of yield and yield attributing characters. Heterosis to the extent of 17.8, 18.1, 70.0, 150.0, 68.7, 48.4 and 181.5 per cent over better parent was recorded for vine length, number of primary branches, female flowers and fruits per plant, average fruit weight, flesh thickness and yield per plant, respectively. The crosses between high x low performing (GCA) parents exhibited greater hybrid vigour. Heterosis for yield was generally accompanied by heterosis for yield components. Ten promising crosses were identified for developing high yielding.

Studying an 8 × 8 half diallel cross of pumpkin (*Cucurbita moschata* Duch. ex. Poir.) for yield and its attributing traits at 2 locations, **Mohanty *et al.* (1999)** revealed preponderance of dominance and non-additive gene action for all the characters supported by low heritability in narrow sense. Pronounced epistasis was observed for number of female flowers and fruits, average fruit weight and yield/plant. Over dominance was prevalent for all the traits. Frequent occurrence of dominant genes among parents for vine length and flesh thickness and recessive genes for the remaining characters were indicated. Most dominant genes exerted

positive effect. However, unequal distribution of positive and negative alleles showing dominance in parents was recorded for all the characters except number of primary branches/plant. Polygenic inheritance of yield and yield contributing characters were detected. Heterosis breeding was suggested for improvement of yield and yield components in pumpkin.

Sirohi and Behera (2000) evaluated twenty-eight *C. moschata* F_1 hybrids involving 8 genotypes as parents (Pusa Vishwas, S-107-B, S-124-10, NDPK-24, S-15, S-12, S-20, and S-17) in half diallel fashion to study the gene action of yield and its contributing characters. Dominant gene action was observed for all the characters, viz. vine length, fruits per plant, fruit weight, and yield per plant. In all these characters, dominance component of variance was greater than the additive component of variance. The heritability in narrow sense was found to be less than 0.50 for the majority of characters. Low narrow sense of heritability coupled with higher degree of non-additive gene action (dominance variance) in yield and its components suggested that heterosis breeding might be advantageous for obtaining higher gains in pumpkin.

Mohanty (2001) evaluated twenty-eight non-reciprocal F_1 hybrids of pumpkin (*Cucurbita moschata*) with parents for 6 quantitative traits at 2 locations in Orissa, India. The pooled analysis revealed dominance and non-additive gene effects for all the traits along with low heritability in narrow sense. Epistasis was observed for number of female flowers and fruits per plant, average fruit weight and yield per plant. Overdominance was noted for all the traits. Frequent occurrence of dominant genes among parents was noticed for days to flowering of first female flower and node on which first female flower appeared, and recessive genes for the remaining traits. Most dominant genes in parents exerted negative effects for earliness and positive effects for other traits. Uneven distribution of positive and negative alleles showing dominance in parents was recorded for all the traits.

Mohanty and Prusti (2002) studied the heterosis for 7 traits (number of days to anthesis of first male flower, number of days to